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AUTHOR Muston, Ray; Wagstaff, Rita
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ABSTRACT

A two year pilot study of interactive computing in teacher education began in 1973 at the University of Iowa. Project planning included provisions for four support systems--faculty involvement, technical support, communication and hardware and facilities. A committee of representative faculty and staff had responsibility for planning, program development and evaluation procedures. A Computer Based Education Laboratory was established with terminals hardwired to the central university computing system. To stimulate faculty interest and development, a survey to solicit expressions of interest was conducted, followed by workshops in instructional technology and computer-assisted instruction (CAI). There has been a continual increase in the use of the computer system by both undergraduates and graduate students. Student and faculty materials development has remained fairly constant. In attitude surveys students agreed that the computer is a useful instructional tool. Evaluation of cognitive gains by student users showed learning was facilitated by the CAI modules. Future plans include continuing support for faculty development, distribution of products and continued evaluation of results. (KB)

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COMPUTER BASED EDUCATION IN TEACHER EDUCATION: AN INSTITUTIONAL DEVELOPMENT STRATEGY

RAY MUSTON

[illegible]TA WAGSTAFF

UNIVERSITY OF IOWA
COLLEGE OF EDUCATION
IOWA CITY, IOWA 52242

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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ABSTRACT: A 2 year pilot study of interactive computing in teacher education began in 1973 at the University of Iowa. Included is a discussion of the organization, cooperation of university units, goals, implementation, results, and future plans involved in integrating human and hardware technology.

INTRODUCTION

C. F. Hoban, in his discussion of the management of educational technology, noted "...technology, in its modern usage, involves the management of ideas, procedures, money machines and people in the instructional process." (Hoban, 1968) Even so, many who would introduce computer based instruction into the curriculum focus on machines and the "technical language" and give limited, if any, attention to the needs and motives of those they intend to serve. Consequently, meaningful efforts are often doomed to failure even before they are presented to students and faculty directly concerned with curriculum development.

The purpose of this paper is to present one college's effort to systematically develop a plan to introduce computer based education in the ongoing curriculum. Through the planning process, a concerted effort was made to integrate hardware acquisition and the design of technical support systems with a more fundamental commitment to faculty development. Institutional development was viewed as the product of systematic integration of collective contributions of creative faculty, staff and students to new applications of ideas, material and hardware for improved learning.

DEVELOPMENT OF INSTITUTIONAL COMMITMENT

An analysis of computing applications at the University of Iowa conducted in 1972 revealed that only 15 percent of total computer usage was committed to instruction. Most instructional applications were designed to teach research methodology with practically none targeted for undergraduate instruction. A preliminary plan was developed to introduce interactive computing in undergraduate curricula throughout the campus. The preliminary plan included recognition of the critical necessity for attention to each of the following support systems:

1) A system to facilitate faculty involvement in the planning and development process,
2) A system to provide necessary technical support,
3) A system to provide essential communication among participating groups and activities,

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and,

4) A system of hardware and facilities to support emerging development and implementation.

The initial plan for an experimental project was visibly supported by the Director of the Computer Center and the Vice President for Educational Development and Research. Together, they acknowledged the need for collegiate faculty involvement and support and announced a commitment to the acquisition of an integrated system of mini-computers to provide hardware support. At the same time, support staff of the Computer Center were designated to assist collegiate units in their systems development. (Weeg, 1972)

Selected colleges were invited to participate in the project. If a unit elected to participate, the Dean was asked to designate a planning committee to work with the Office of the Vice President for Educational Development and Research and the Computer Center. Each collegiate planning committee was to have responsibility for site planning, necessary training and development, and evaluation of project development.

The procedure for initial planning provided several essential ingredients for effecting change or development in academic organizations.

1. The proposed project had visible support from the University central administration.
2. A commitment to technical staff support was assured.
3. Collegiate systems received a commitment of support from the dean through the designation of a planning committee.
4. An integrated system of hardware support was committed.
5. A system of communications among university administration, computer center support staff, and collegiate units was established through interlocking planning committees.
6. Above all, a vehicle for faculty involvement in the planning and development process was identified in the form of planning committees at the collegiate level. The substance and direction of program development efforts were the responsibility of faculty planning committees.

DEVELOPING FACULTY INVOLVEMENT AND COMMITMENT

Numerous studies have shown that the inclusion of those most directly affected by plans and decisions leads to better input and ultimate results. Similarly, involved professionals are also more committed to goals and programs they have helped develop. Above all, innovative development of instructional programs is most effectively and efficiently realized through the effort of those with greatest expertise - the faculty. Thus, responsibility for early planning effort was assigned to representative faculty and staff committees at the collegiate level.

Representatives named to the College of Education Computer Based Education Committee included:

- -A senior professor with a strong computer background,
- -A senior professor with a strong background in learning theory and instructional design,
- -A junior professor from secondary education with prior experience in computer assisted instruction,
- -A junior professor from educational media and instructional development,
- -A junior professor from elementary education,
- -A graduate student in educational psychology,
- -An undergraduate student in elementary education, and
- -An assistant dean.

The college committee was strategically selected to include staff with prior experience in the use of the computer, instructional design and development, and positive approaches to faculty development. Also, the two largest undergraduate programs (elementary and secondary education) were represented as well as the office of the dean. The committee was structured to facilitate complementary input of students, faculty, and administrative staff.

Nominations to the committee were made from a list of individuals who had responded positively to a survey of interest in computer assisted instruction.

The charge of the committee included responsibility for site planning, a plan for systematic program development, and articulation of procedures for project evaluation.

ARTICULATION OF PROJECT OBJECTIVES

The college planning committee focused its initial attention to the development of project objectives which were to serve as guidelines for project development as well as a reference point for coordinated direction for interested faculty and staff.

The recognized goal of the experimental project was to make a significant impact on the use of computer based education in undergraduate curricula. The committee recognized that improved instructional effectiveness and acceptance of products developed would be contingent upon deliberate examination of each step of the instructional design process. If the total development process was to succeed, committed faculty would need time, technical support and recognition for instructional design, software development and evaluation efforts. Emphasis was given to the reality that significant contributions would result from programs which were developed from deliberate analysis of instructional needs rather than CAI packages constructed as ends in themselves in search of a problem.

The following general objectives were articulated by the planning committee.

1. Stimulate Faculty Development: Identify a core of committed faculty to develop specific computer based education programs and provide sufficient released time for program planning, development, and evaluation. Those selected would become the nucleus for continuing program development.

2. Maximize Student Impact: Select and develop projects which could result in immediate impact on a significant number of students in the undergraduate teacher education program.
3. Integration of Instructional Media: Explore and develop the potential of computer based technology as a complement to existing media and methodologies. Concurrently, the plan called for establishment of a support lab to provide continuing hardware, software, and technical support to faculty and students.
4. Promote the Acceptance of Computer Based Education: Through project design, field testing, and evaluation, provide a support base for computer based education programs as effective learning strategies.
5. Development of Generalizable Products: Through all of the above, the College committee was committed to develop programs and products which could be transferred and implemented at sister institutions throughout the country.
6. Continuing Faculty Development: As a part of the total plan, it was intended that the total project would provide an incentive and example for continuing faculty development and utilization of computer based education programs and materials.

These objectives were intended to integrate the commitment to hardware accessibility, faculty support and development, and broad student access.

IMPLEMENTATION PLANS AND STRATEGIES

Through a statement of project goals and objectives, the planning committee sought to clarify expectations for the project. Still, plans to identify and assure necessary space, hardware, personnel and software support remained to be developed.

Physical Facilities: The committee emphasized three criteria in their plan for physical facilities for the computer based education project. 1) A space large enough to accomodate a critical mass of terminals was essential. Efficiency of student utilization was not to be constricted by thin distribution of available hardware. 2) Space for the computer based laboratory should be in close proximity with other elements of instructional resources in the Learning Resources Center. 3) Facilities should be provided in an environmental setting which would be pleasing to users.

Space adjacent to the existing Curriculum Laboratory was reassigned for use as a Computer Based Education Laboratory. An interior designer from a local architectural firm was engaged in a plan to renovate and furnish the reassigned space.

The laboratory was carpeted, walls and ceiling treated with acoustical tile and complimentary colors, and furniture was selected to complete the decor. A partition was designed to give privacy to a work space for a lab coordinator.

Facilities have proven to be functional and attractive.

Hardware: Because the basic support system had already been selected by the central planning committee and eight terminals (four CRTs and four TTYs) assigned to the College of Education, the primary concern of the college committee focused on proper distribution and functional assignment of available terminal hardware. The committee expressed commitment to optimum accessability for student users, special support for restricted faculty development, and flexibility.

Six terminals were clustered in the Computer Based Education Laboratory and hardwired to the central system. Two terminals were designated for faculty development and placed in locations isolated from the lab for uninterrupted faculty use (one CRT and one Teletype). Thus, no direct supervision or technical support was available with development terminals. Two of the eight ports assigned to the college were maintained as tele-ports to assure hardware mobility and flexibility.

During the first year of the project, data showed that the faculty development terminals were receiving little use. It was decided to bring the CRT into the student lab and trade the TTY for a variable speed portable Texas Instrument Silent 700 which could be taken into public schools for demonstration and to other campuses for extension courses. The portable terminal has also received substantial use in faculty development.

Within six months, it became apparent that developers would be able to accomplish more if they were not interrupted by laboratory activity. An office isolated from the student lab, but nearby, was designated as a development office and a CRT terminal was moved to provide a quiet place for both student and faculty development.

The TTYs are now over two and one-half years old. They receive one-third to one-half the use of CRTs. Only people who must have hard-copy are willing to use the slower TTYs. Because the TTYs have depreciated over half their expected five year life, maintenance is becoming a problem. Also because of their slow speed and high noise level, consideration is being given to replacing the TTYs with DEC writers or some similar device one at a time over the next three years. Some hardcopy devices are necessary for developers who need listings and for users who want print-out. There is presently no plan to replace the Beehive CRTs which have provided good service while receiving more use than the TTYs.

Personnel-Faculty Resources: The committee recognized faculty and staff support as being the most crucial element of their effort to develop an ongoing computer based education program. Few faculty had prior experience in instructional applications of the computer; software directly applicable to teacher education was not immediately available; and no systematic program for staff development had been identified. Thus, the committee outlined steps to:

1) Create an awareness of the potential role of computer based education in teacher education,
2) Provide resource support for faculty who expressed interest in the project,

3) Provide access to available software, and
4) Encourage recognition for development efforts.

A survey of all faculty in the college was designed to solicit expressions of interest. Responses from the survey were used to identify projects which could lead to early success and implementation. An early effort was made to develop a proposal for external funding to support project development throughout the university. Internal resources of the college were identified and reallocated to support selected development projects.

Probably the single most effective event in stimulating C.A.I. development was the intercollegiate sponsorship of a simulation designers workshop presented in the fall, 1974. Dr. James Bobula of the University of Illinois Medical Education Center spent two and one-half days assisting designers in developing paper and pencil simulations. Some of the paper and pencil simulations were later expanded and implemented on the computer. Some of these modules become the core research for Ph. D. dissertations as well as other research studies.

Other major events include summer grants given by the University Computer Center and University Council in Teaching to professors to develop C.A.I. materials. Courses in C.A.I. languages and more general Computers in Education courses have aroused interest in students which frequently results in development modules. Local newspaper and University press releases have devoted articles to computing and its impact on education and to individual faculty projects being developed at the University.

A day-long faculty retreat was held off-campus which focused on the innovative use of instructional technology. The Dean encouraged faculty members to dismiss classes for the day so all faculty and students who wished to would be able to attend.

Continuing interest in computer simulation has led to two additional simulation designers workshops presented locally by participants of earlier workshops who progressed into more sophisticated computer application techniques.

An information exchange with the other Regents institutions led to additional interest in development. A similar exchange with the University of Nebraska at Lincoln should also stimulate development.

There has been a great deal of promotional activity in order to create an awareness of computing and its value as an instructional aid. A number of users and developers are involved and regularly utilize the facilities provided. Attention is now being turned to those users who are interested but who do not have the time or expertise to complete projects who are in areas which have made little use of computing. There is a core of sophisticated users who assist their faculty colleagues with new development. In this way, the expertise of a few can be viewed as a multiplier throughout the college.

The Computer Based Education Committee has formally recommended recognition for faculty development of software in promotion and tenure decisions.

An analysis of our brief history has shown a positive relationship between developmental events and the incidence of usage.

Personnel-Staff Support An early commitment was made by the College administration and the faculty developers and student users. Resources were thus committed to basic support positions. The goal of the computer lab staff was to provide basic development support and general continuity to lab users and developers.

The initial personnel consisted of a half-time graduate assistant who had five years batch programming experience. General direction came from the Associate Dean of the College. Later, another half-time graduate assistant programmer was added. The two students split the responsibilities into promotion-administration and programming. The students shared responsibility for assisting lab users.

A year and a half into the project, the status of both graduate assistants was changed from half-time to three-fourths-time. Another half-time graduate student was added temporarily for development of a specific project. A work study programming assistant was added for a summer project. Concurrent support was provided for graduate student input as content specialists in selected projects.

After three years the staff was expanded to incorporate a full-time coordinator, a half-time graduate assistant programmer, a student programming assistant, a secretary shared with the adjacent Media Lab, and a student typist also shared with the Media Lab. The coordinator reports to the Associate Dean of the College and serves as an ex-officio member of the College Computer Advisory Committee.

Throughout the project, the advice of C.A.I. consultation at the University Computer Center has been invaluable. The Computer Center has also provided BASIC and IDF language workshops as well as other workshops related to computer usage.

As part of the Learning Resource Center which also includes Curriculum and Media Laboratories, and the Education-Psychology Library, the Computer Laboratory is able to draw on the expertise and technology of these resources for multimedia module development.

The combined efforts of many people have gone into making the Computer lab operational.

Software The coordinator of the Computer Lab assumed responsibility for the identification and preview of software packages external to the College which might prove beneficial in the teacher education program.

New package titles developed by students and faculty within the College are listed below. (A complete description of projects is available upon

request.)

DRILL AND PRACTICE

Math - Basic math review and remediation.
Media - Review questions for midterm and final exams.
Spanish - A brief program reviewing grammar of the present tense in Spanish.

TUTORIAL

Systems Approach - An introduction to the systems approach as it pertains to education.
Learning Theory - To teach political science students the implications and applications of learning theory to socialization.
Interaction Analysis - Teaches students the category system of Flander's analysis; applies the knowledge using audio tape conversations of students and teachers which students learn to evaluate.
Behavioral Objectives - A tutorial introduction to writing behavioral objectives.
Photosynthesis - A tutorial on the photosynthetic reaction.
Math - A series of programs on complex numbers.
Computer Programming - An IDF program to teach IDF users who have had no computer experience.
Photography - A tutorial which leads beginning students through the meaning and use of depth field.
Educational Administration - A tutorial program which teaches the basic concepts, conditions, formulas, and types of queues.
Statistics - A teaching module which stresses key points in statistics and allows students to build sampling distributions using simulated data.

SIMULATION

Photography - This program teaches students how to process Ektachrome film using a simulated darkroom.
Photography - Instructs beginning photography students in the process of making black and white prints.
Statistics - Computation modules in Bayesian Statistics where students input data and are able to observe the results.
Computers in Education - Introductory program dealing with different aspects of interactive computing in instruction.
Math Education - Teaches prospective elementary school teachers the basic vocabulary and nomenclature.
Classroom Test Development - Teaches how to compose effective classroom tests from a pool of 100 items. Gives statistics from the test produced.
Elementary Science - A 4-lesson simulation on force and motion accompanied by film loops.
Delphi Inquiry Method - Program on the Delphi technique with simulation and tutorial modes.
Sociological Game - GHETTO, where students are presented situations encountered by ghetto-dwellers and try to improve the ghetto conditions through their decisions.
Law - Two simulations which teach problem solving in civil procedure. These are being used in first year civil procedure classes at University of Iowa law school.
Teacher Education - A set of classroom management simulations for student teachers of elementary grades.
Teacher Education - Series of management simulations which confront science education student teachers with classroom situations about which they must make decisions.
Counseling - Simulation for counseling education students where the student is faced with a client and the student must make decisions about the problems.
Teacher Education - Questioning Techniques --A simulation in which student teachers "ask" questions to gain skill in achieving teaching objectives through questioning.
Teacher Education - Elementary Math -- Elementary math simulation -- a course to assist teachers in diagnosing and tailoring elementary math to meet the special needs of the students.

COMPUTER-MANAGED INSTRUCTION

Instructional Design - 12 CMI modules which test over readings in instructional design.
Computers in Education - Eight CMI modules which survey computer application in education.
Teaching of Reading - A CMI diagnosis and prescription reading program.
Counseling - Two testing modules for counseling students.
Media - A test item pool containing more than 2000 items to generate tests covering a range of experience in educational media. For IBM 360 system.

EVALUATION

Evaluation of the project, and products which emerged from the development effort, focused on four primary concerns.

1) Have development efforts resulted in increased student use of computer based instruction?
2) How have students reacted to the introduction of computer-based units in their classes?
3) How can support facilities and services be improved?
4) Above all, can any measurable indicators of improved learning effectiveness be identified?

In the academic year prior to the arrival of the Hewlett-Packard interactive system, (1972-1973) 344 graduate and upper division students used the IBM 360/65 system primarily for research in 11 classes. The first semester that the H-P was available, there were 582 undergraduate and graduate students in nine courses using the H-P system. There has been a continual increase in H-P use by both undergraduate and graduate students.

Student and faculty development has remained fairly constant since the beginning of the H-P project. Currently there are 28 major instructional modules completed and three still in development.

Table I reports the use data since the beginning of the project.

TABLE 1

USE SUMMARY

	1973 Fall	1974 Spring	1974 Summer	1974 Fall	1975 Spring	1975 Summer	1975* Fall	TOTAL
# courses	9	17	10	17	12	13	12	90
# students								
Users	582	681	118	786	558	246	583	3554
Developers	11	4	4	7	8	4	2	44
# faculty								
Users	9	18	10	15	9	12	14	87
Developers	7	2	4	2	4	2	2	22
Terminal Time (minutes)	52617	141079	59680	133241	144401	69705	81792	682515
# sign-ons	1943	3844	1663	3931	5044	2823	2668	21916

* December, 1975, estimated from December, 1974

Currently, conditions, costs, and distrubution of materials are concerns with developers. The Computer Laboratory, is cooperating with CONDUIT, an established distributor of computer materials. CONDUIT is just beginning to handle education and interactive modules.

It has been the policy of the lab to maintain records of events and/or strategies of promotion and note the result in terms of operation, development, and student use. For example, the isolated development terminals intended for faculty use sat idle much of the time. The faculty seldom directly programmed or entered their materials. Students who assisted faculty often needed programming assistance so when the development terminals were relocated nearer the lab programming assistants, their use increased.

Students were exposed to both instructional programs and computing as an instructional aid. An attitudinal survey regarding several facets of the computer and computer related applications was thus administered to a sampling of all students. The attitude survey polled 19 undergraduate and graduate students in the summer of 1974; 142 in fall, 1974; and 125 in spring, 1975.

Results of the largest sample (142) indicated that 90 percent of the students had never used a computer before. Ninety percent agree that the computer was a useful tool of instruction. Although 85% said they had no knowledge of programming languages, 70% reported that they would like to take more courses using the computer though not necessarily to program for it. About 50% said if a computer were available, they would use it in their own teaching. However, 50% felt that a computer course should not be required for either a degree or teacher certification.

Process evaluation of plans for support facilities and services was conducted throughout the project. Thus, developmental terminals were relocated to better serve user needs and staff allocations were adjusted according to emerging demand.

Evaluation of cognitive gains and learning effectiveness has been a structured objective within all projects. One complete module reports results of a multimedia series which teaches Flanders' Interaction Analysis to undergraduate social studies methods students. This module shows that of a possible 22 post-test responses, the experimental computer group (N=14) had six perfect scores and five scoring 21. The lowest score was 19. In the control group (N=13) matched to the experimental group on ACT and cumulative grade point average, the high score was 20 and the low was 13. Time compression was also significant. The experimental group spent 2.2 hours in instruction, the control group 3.3. It also appears that students with low ACT and GPA generally performed better via C.A.I. than with the traditional method.

Similar results were obtained in a series of four film loop and computer simulations to teach the relationship of force and motion according to Newton's Second Law. Three groups were used. One group viewed the films and used the computer simulation, a second group studied the same material using non-computerized simulation materials and a science lab, and a third received the usual lab and class instruction. The computer group spent a minimum of one hour and forty minutes on the terminals. They did no outside work on the material. The student who had benefit of the lab and simulation material spent six forty-minute periods on the material plus 45 minutes for each student outside class. The regular lab group spent between nine and eleven fifty-minute periods on the material plus twenty to thirty minutes on homework. The ratio of concept learning for the computer group compared to the regular lab group was 8:3 to 1. The group which received access to the simulation materials and film but not via the computer fell between both other groups in achievement and time spent. Retention after a six month period was significant for all groups, but especially for the computer and regular lab group.

Other results have not used control group designs but have used pre-post test comparisons, all of which show learning was accomplished with the C.A.I. modules.

CONCLUSION & FUTURE PLANS

The University of Iowa College of Education Computer Based Education project has had a significant impact on both student users and faculty developers. The project was the result of a cooperative effort which included the University administration, College administration, College faculty, Computer Center, Computer Lab staff, and students in the College.

This integration of human hardware technology has made possible instructional development which otherwise would not exist. One result of this integration has been to provide a new mode of instruction to students in the teacher education programs at The University of Iowa. Perhaps the most exciting results have been where learning was more effectively achieved through C.A.I. than through traditional classroom methods.

Future plans include commitments to:

1) Continuing support for faculty development,
2) Special workshops to train secretarial and part-time staff in IDF and user assistance,
3) A program of student orientation to the lab and its resources is being revised,
4) Distribution of products through CONDUIT is being negotiated and,
5) Continuing evaluation of project results.

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